PROGRAMMED INSTRUCTION

ACCELEROMETERS

Q-6A

Naval Air Technical Training Command

CNATT-M160 PAT

OBJECTIVES

Q-6A--Accelerometers

The student will:

1. Match the following words with their correct definitions:

    a. speed
    b. velocity
    c. acceleration
    d. accelerometer
    e. inertia
    f. "G" units.

2. Write the formulas used to calculate velocity and acceleration.

3. State whether each given characteristic of an accelerometer pertains to a linear or to an angular accelerometer.

4. State the input to a linear accelerometer.

5. List the three basic components required in a linear accelerometer.

6. State why a restraining and damping system is necessary in a linear accelerometer.

7. State two methods used to achieve damping in most linear accelerometers.

8. State the purpose of an indicator and a heater used with a linear accelerometer.

9. State the three types of information which can be read on an aircraft vertical accelerometer ("G" meter).

10. State four general uses of linear accelerometers.

NAVAL LEADERSHIP

GENERAL ORDER
NO. 21

NAVY DEPARTMENT
WASHINGTON, D. C., 1 May 1963

LEADERSHIP IN THE UNITED STATES NAVY AND MARINE CORPS

Part I—Discussion

The United States Navy-Marine Corps records of victorious achievements on land, at sea, and in the air in peace and war have won for these services an honored position in our great nation. This heritage was passed on to us by our leaders, both officer and enlisted, whose outstanding examples of courage, integrity and devotion to duty are historically significant. They accomplished their missions successfully by high caliber leadership and personal example. The strength of our nation and of our services depends upon courageous, highly motivated and responsible individuals.

Part II—Objective

The objective of this general order is to achieve an ever-improving state of combat readiness by:

a. Emphasizing that successful leadership at all levels is based on personal example and moral responsibility.
b. Insuring that every man and woman are themselves examples of military ideals.
c. Requiring personal attention to and supervision of subordinates.

Part III—Action

1. The Chief of Naval Operations and the Commandant of the Marine Corps shall be directly responsible for maintaining optimum leadership standards. The Under Secretary of the Navy shall be responsible for the proper implementation of this order.

2. Fleet, Force, Type and Administrative commanders shall review each command's leadership posture as an integral part of military inspections and shall include their evaluation in inspection reports.

3. Every command and every major office and bureau of the Navy Department shall, on a continuing basis, review its leadership standards; each shall take effective measures to improve them and shall develop an awareness of the need for good leadership by providing programs for instruction in leadership principles and practices.

4. All persons in responsible positions, military and civilian, shall require that their subordinates discharge their duties in accordance with traditional concepts of Navy and Marine Corps standards, paying particular attention to:

a. Moral responsibility.
(Article 0702A, Navy Regulations—Paragraph 5390, Marine Corps Manual.)
b. Personal example of behavior and performance.
(Article 1210, Navy Regulations—Paragraph 5390, Marine Corps Manual.)
c. Established standards for personnel development.
(Article 0710, Navy Regulations—Paragraph 1500, Marine Corps Manual.)
d. Integration of principles and practices of leadership into everyday routine.
(Article 0709, Navy Regulations—Paragraph 5390, Marine Corps Manual.)
e. Effective organization and administration.
(Article 0704, Navy Regulations—Paragraph 3000, Marine Corps Manual.)

FRED KORTH
Secretary of the Navy

NAVPERS 15202

1. One of man's greatest challenges is to be able to measure and control the movement of an object from one place to another. An understanding of the basic terms and concepts of motion is important in order to meet this challenge. Motion is measured both in terms of displacement and in terms of force. Velocity, speed, and acceleration are measurements of motion in terms of displacement. Inertia, momentum, and G units (gravitational units) imply the measurement of motion in terms of force.

The following sequence will enable you to:

a. Match the definitions of speed, velocity, acceleration, inertia, G unit, and accelerometer with their meanings.

b. Write the formulas for velocity and acceleration.

NO RESPONSE REQUIRED

	2. Velocity is defined as the rate of change of position. In other words, it is the change of position with respect to time. Speed is defined as the magnitude (amount) of velocity. The two words are often used interchangeably, but speed implies less than velocity; speed implies only magnitude, while velocity implies both magnitude and direction (an actual changing of position). Acceleration is defined as the rate of change of velocity; it is the change of velocity with respect to time. The magnitude of velocity is called ________________. The rate of change of velocity is called ________________. The rate of change of position is called ________________.
speed acceleration velocity	3. Match the following words with their correct definitions. a. Acceleration b. Velocity c. Speed ____ The rate of change of position. ____ The rate of change of velocity. ____ The magnitude of velocity.

b. a. c.	4. Inertia is defined as the property of a mass to resist any change in its state of motion. (The term momentum is sometimes associated with inertia. Momentum is the property of a moving body that determines the length of time to bring it to rest when acted upon by a constant force.) A G unit is a measurement of force using normal weight (as determined by gravity) as a reference. An accelerometer is a mechanical instrument used to detect a change in velocity. An accelerometer measures acceleration by measuring G units. The measurement of force using normal weight as a reference is a(n) ________________. The property of a mass to resist any change in its state of motion is called ________________. A mechanical instrument which detects any change in velocity is called a(n) ________________.
G unit inertia acceler-ometer	5. Match the following words with their correct definitions. a. G unit ____ The property of a mass to resist any change in its state of motion. b. Accelerometer ____ The measurement of force using normal weight as a reference. c. Inertia ____ A mechanical instrument which detects any change in velocity.

c. a. b.	6. Newton's second law of motion states that the acceleration (a) of a body is directly proportional to the force (F) applied to that body and inversely proportional to the mass (M) of that body, $$a = \frac{F}{M}.$$ A convenient method of measuring acceleration is by using the normal weight of the body as a reference and calling that one G unit. A 170-pound man is in an aircraft flying straight and level; the only force felt by him is his normal weight; he is experiencing 1 G, $$a = \frac{170}{170}\left(\frac{\text{Force}}{\text{Mass}}\right) = 1 \text{ G unit.}$$ However, if the plane suddenly climbs (accelerates upward), he may feel a force of 340 pounds being applied to him; he is experiencing 2 G's of vertical acceleration, $$a = \frac{340}{170} = 2 \text{ G's.}$$ If the aircraft enters a dive, he may suddenly feel weightless because the force applied to his body is less than the normal force of gravity; he is experiencing 0 or negative G's, $$a = \frac{0}{170} = 0 \text{ G's.}$$ Continue to next page.

	6. (Continued) Acceleration can also be measured in a horizontal plane by the same means. An example of G forces in a horizontal plane is the action of a human body in an automobile as it starts or stops suddenly. The acceleration of an object can be measured by using its normal weight as a reference and calling that one ________________.
G unit	7. Complete the following definitions: a. The rate of change of position is called ________________. b. The rate of change of velocity is called ________________. c. The magnitude of velocity is called ________________.

a. velocity b. acceleration c. speed	8. Velocity is the rate of change of position; it is calculated by dividing the distance travelled (displacement) by the amount of time required to complete the change of position, as shown by the formula $$V = \frac{s}{t},$$ where V = velocity, s = distance (amount of displacement), and t = time. Acceleration is the rate of change of velocity; it is calculated by finding the difference between final velocity and initial velocity and dividing that difference by the amount of time required for the change, as shown by the formula $$a = \frac{(V - V_o)}{t},$$ where a = acceleration, V = final velocity, V_o = initial velocity, and t = time. Write the formulas used to calculate velocity and acceleration. $V =$ $a =$

$V = \frac{s}{t}$ $a = \frac{(V - V_o)}{t}$	9. a. An aircraft flies 300 miles in 2 hours. Its velocity is ____ miles per hour. Show your work. V = __________ b. If the velocity of an aircraft increases from 450 miles per hour to 600 miles per hour in 5 minutes, the acceleration of the aircraft is ____ miles per hour/per minute. Show your work. a = ____________
a. $V = \frac{s}{t}$, $V = \frac{300}{2}$, $V = 150$. b. $a = \frac{(V - V_o)}{t}$, $a = \frac{(600-450)}{5}$, $a = \frac{150}{5}$, $a = 30$.	10. Complete the following definitions: a. A mechanical instrument which detects any change of velocity is called a(n) _________________. b. The property of a mass to resist any change in its state of motion is called _________________. c. The measurement of force using normal weight as a reference is a(n) _________________.

a. accelerometer b. inertia c. G unit	11. Dividing distance travelled by the amount of time required to change position results in the calculation of ________________. Dividing the difference between final velocity and initial velocity by the time required to change velocity results in the calculation of ________________. Write the formula for velocity. Write the formula for acceleration.
velocity acceleration $V = \frac{s}{t}$ $a = \frac{(V - V_o)}{t}$	12. Match the following words with their correct definitions by placing the letter of the word in the space provided. a. Speed b. Velocity c. Acceleration d. Accelerometer e. Inertia f. "G" unit ____ The rate of change of velocity of a moving object. ____ The property of a body at rest to remain at rest. ____ The magnitude of velocity. ____ The measurement of force using normal weight as a reference. ____ Mechanical instrument used to detect a change of velocity. ____ The rate of change of position.

c. e. a. f. d. b.	13. Write the formulas for velocity and acceleration. a. Velocity -- b. Acceleration --
a. $V = \frac{s}{t}$ b. $a = \frac{(V-V_o)}{t}$	14. Accelerometers are mechanical instruments used to detect changes of velocity. Changes of linear (straight-line) velocity are measured with linear accelerometers which are sensitive to straight-line motion. Changes of angular (rotational) velocity are measured with angular accelerometers which are sensitive to changes of rotational motion. The following sequence will enable you to determine whether each given characteristic of an accelerometer pertains to a linear or to an angular accelerometer. NO RESPONSE REQUIRED
	15. A linear accelerometer measures changes of linear (straight-line) velocity. It consists basically of a <u>movable</u> <u>mass</u> which reacts to any acceleration felt along its sensitive axis (the line along which it is allowed to move). Continue to next page.

	15. (Continued) The basic component of a linear accelerometer is a _________________ _____________________. A linear accelerometer measures changes of linear velocity which occur along its _________________ _________________.
movable mass sensitive axis	16. A linear accelerometer is constructed so that (choose one of the following) a. its movable mass reacts to changes of linear velocity which occur along its sensitive axis. b. it measures any change of velocity which occurs along any axis not parallel to its sensitive axis. c. its movable mass reacts to any changes of "straight-line" velocity which do not occur along its sensitive axis.
a.	17. Changes of rotational velocity are measured indirectly by using an angular accelerometer which, in most cases, is a <u>modified</u> rate gyro. A rate gyro is sensitive to a rate of change of angular velocity. By differentiating the output of a rate gyro, angular acceleration (the <u>change</u> <u>in</u> <u>the</u> <u>rate-of-change</u> of rotational velocity) is obtained. NOTE: Differentiation is a mathematical process by which changes in rates of change are detected. (If there is a constant rate of change, there is no output. Any increase or decrease in a rate of change produces an output which is proportional to positive or negative angular acceleration.) Continue to next page.

	17. (Continued) Select the correct statement(s) concerning an angular accelerometer. a. It is no different from a linear accelerometer. b. It has a differentiated output. c. It is usually a modified rate gyro. d. It measures angular acceleration directly. e. It measures the rate of change of rotational velocity.
b. c. e.	18. Angular acceleration cannot be measured directly. With a rate gyro, changes of angular (rotational) velocity can be detected as a rate of change. The output of a rate gyro, when differentiated, represents a change in the rate of change of angular velocity--angular acceleration. A modified rate gyro can be used as a(n) ________________ accelerometer. In order to represent angular acceleration, the output of a modified rate gyro must be ________________. Angular accelerometers are usually modified ________________ ________________.

angular differentiated rate gyros	19. A linear accelerometer consists basically of a movable mass which reacts along its sensitive axis to a change of linear motion. Mark the answers to the following statements true (T) or false (F). A linear accelerometer can be used to measure _____ a. the acceleration of a drag racer. _____ b. the force of gravity on an aircraft during a loft bombing maneuver. _____ c. the acceleration of a meteor while tracking it with a telescope. _____ d. the acceleration of a target aircraft while tracking it with a radar antenna. _____ e. small changes along any of the three axes of an aircraft in level flight.
a. T b. T c. F d. F e. T	20. Angular accelerometers consist basically of a modified rate gyro with a differentiated output. The gyro measures the rate of change of angular velocity which is differentiated to produce an output of angular acceleration. Angular accelerometers are used when tracking moving objects to measure the angular acceleration of those objects. This is done by measuring the angular acceleration of the tracking vehicle (antenna, telescope) to which they are attached. Continue to next page.

	20. (Continued) Mark the answers to the following statement true (T) or false (F). An angular accelerometer can be used to _____ a. help solve a fire control problem by measuring the relative angular acceleration between an aircraft and its target. _____ b. help predict an impact point for a meteorite or a space vehicle while tracking it either optically or with radar. _____ c. measure the force of gravity acting on aircraft. _____ d. measure the linear acceleration of the vehicle to which it is attached.
a. T b. T c. F d. F	21. Each characteristic of an accelerometer listed below pertains to either a linear or an angular accelerometer. If it pertains to a linear accelerometer, place an "L" in the space provided; if it pertains to an angular accelerometer, place an "A" in the space provided. _____ a. Usually a modified rate gyro. _____ b. Has a differentiated output. _____ c. Measures rate of change of angular (rotational) velocity. _____ d. Measures straight-line rates of change of velocity. _____ e. Consists of a movable mass.

A. A. A. L. L.	22. A linear accelerometer measures the linear acceleration and deceleration of the vehicle to which it is mechanically connected. It consists, basically, of three components and a supporting structure, as shown on figure 22.

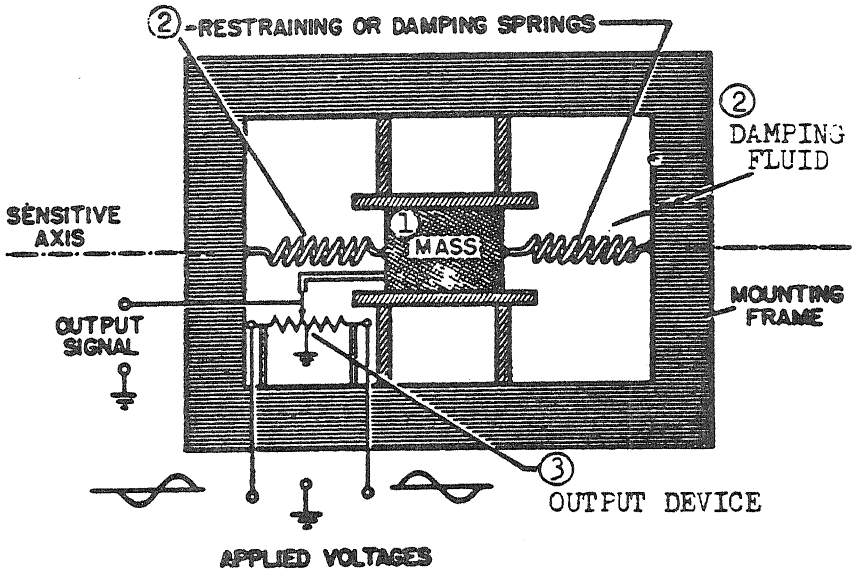


Figure 22 Illustration showing the three basic components in a linear accelerometer.

Any change of velocity of the mounting frame causes the mass (because of its inertia) to resist this change; the mass moves with respect to the mounting frame and produces an output which is proportional in phase and amplitude to the amount of acceleration. The mass is kept from overshooting and oscillating by restraining springs and damping fluid which control any tendencies of overaction.

Continue to next page.

22. (Continued)

The following sequence will enable you to:

a. State the input to a linear accelerometer.

b. List the three basic components of a linear accelerometer.

c. State why damping is necessary in a linear accelerometer.

d. State two methods used to achieve damping in linear accelerometers.

NO RESPONSE REQUIRED

23. A linear accelerometer is mounted so that it responds to any <u>change of velocity</u> felt along its sensitive axis. If acceleration along more than one axis is to be measured, more than one accelerometer must be used. Figure 23 shows the arrangement of accelerometers in an aircraft so that changes of velocity along three axes (X, Y, Z) may be measured.

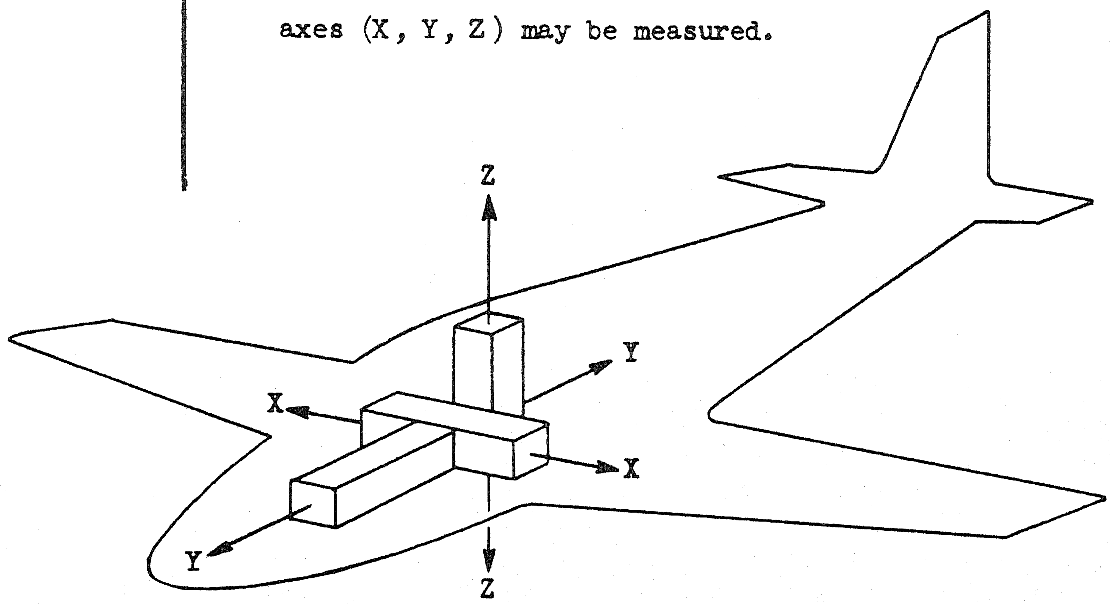
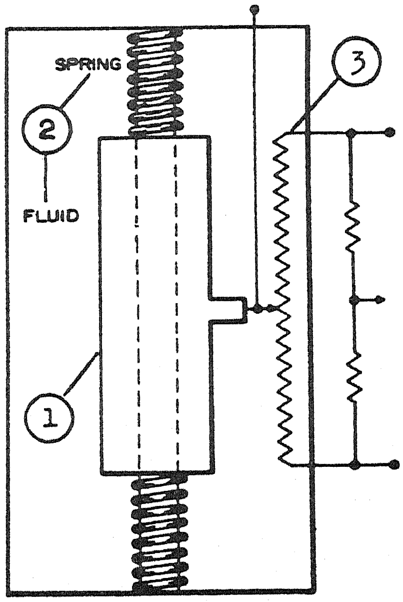
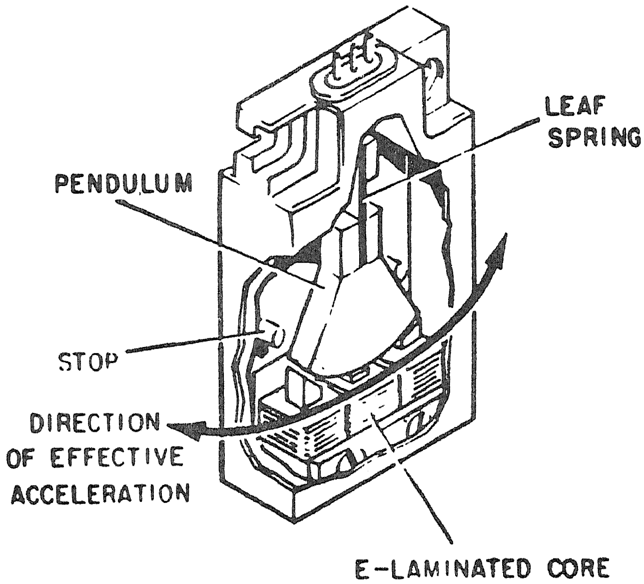


Figure 23

Continue to next page.

	23. (Continued) The input to a linear accelerometer must be applied along its sensitive axis. This input is a change of ________________.
velocity	24. The input to a linear accelerometer is a. a change of speed. b. a change of inertia. c. a change of velocity. d. a change of acceleration.
c.	25. Many types of linear accelerometers exist. Regardless of the type of accelerometer used, however, all consist basically of three components: a movable mass, a restraining and damping system, and an output device. Figure 25 shows a typical vertical accelerometer used to measure vertical acceleration (G's). Label the three basic components of this accelerometer.  Figure 25 (1) ________________ (2) ________________ (3) ________________

1. Movable mass 2. Restraining and damping system 3. Output device	26. The three basic components of a linear accelerometer are a. a movable mass, an output device, and a restraining and damping system. b. a stationary mass, an output system, and a restraining and damping system. c. a movable mass, an output device, and an input system.
a.	27. Figure 27 shows an accelerometer used in a gyroscope assembly to sense changes of velocity which would cause false precession of the gyros.  Figure 27 The input to a linear accelerometer such as the one shown in figure 27 is a ________________

change of velocity	28. Although the mass in a linear accelerometer must be free to move in reaction to a change in velocity, its movement must be <u>controlled</u> so that it does not overshoot or oscillate and induce errors into the output. A restraining and damping system is necessary in linear accelerometers so that the mass does not ______________ or ______________ and induce ______________ into the output.

overshoot

oscillate

errors

29. As the mass responds to a change of velocity, its movement must be restrained and damped by some means, or else it will overshoot or oscillate, thus inducing false signals in the output as shown in figure 29.

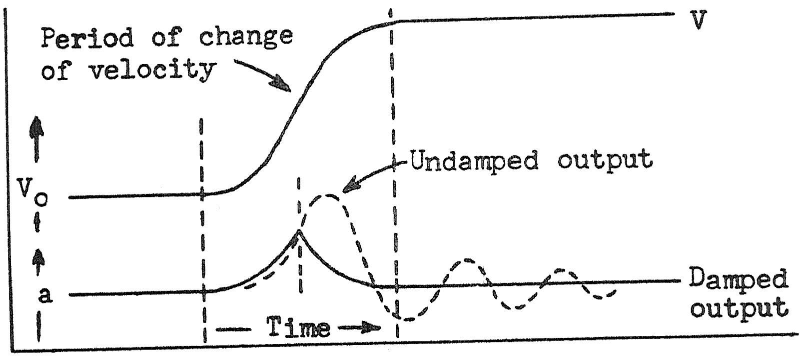


Figure 29

Linear accelerometers require a restraining and damping system so that

a. the mass will overshoot and not induce errors into the system.

b. the mass will not overshoot or oscillate, inducing errors into the system.

c. the mass will not oscillate when errors are induced into the system.

b.

30. Figure 30 shows a schematic drawing of a typical force-balance accelerometer used in some inertial navigation systems to sense minute (.0001 G) changes of velocity. Although it is a highly refined instrument, it consists basically of a movable mass, a restraining and damping system, and an output device. It is filled with damping fluid; however, instead of restraining springs, a magnetic circuit is used to keep the mass centered and to produce an output at the same time. (The output is proportional to the amount of current necessary to keep the mass centered during acceleration.)

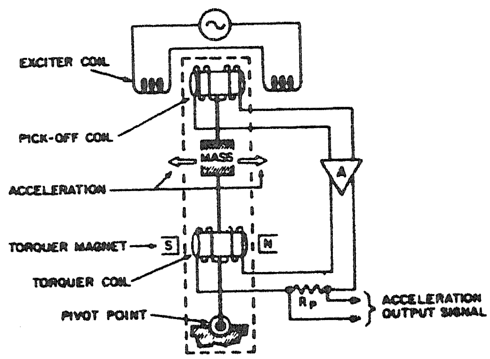


Figure 30

The three basic components of a linear accelerometer are

(1)

(2)

(3)

(1) a movable mass, (2) a restraining and damping system, and (3) an output device.	31. What is the input to a linear accelerometer? ____ ____
A change of velocity.	32. Two methods used to achieve damping in linear accelerometers are: calibrated springs and damping fluid. Most linear accelerometers use both methods. Damping is achieved in most linear accelerometers by the use of calibrated ______________ and damping ______________.
springs fluid	33. From the list below, select the methods which are used to achieve damping in linear accelerometers. a. Calibrated springs. b. Restraining stops. c. Damping fluid. d. Calibrated output devices. e. Acceleration limit devices.

a. and c.

34. Figure 34 shows a pulse-counting accelerometer which provides an output in digital form (pulses) rather than in analog form (changing current or voltage). As the mass is moved by a change of velocity, the brush slides across various contacts, each of which feeds a digital counter circuit. As acceleration stops, the mass returns to a null and resets the counter. The spring and bellows act as a typical restraining and damping system by preventing the mass from overshooting or oscillating and inducing errors into the system.

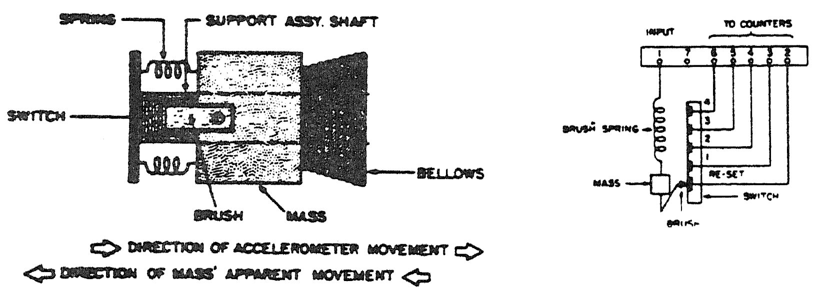


Figure 34

Linear accelerometers, such as the pulse-counting accelerometer, require a restraining and damping system so that ____

____

the mass does not overshoot or oscillate and induce errors into the system.

35. List the three basic components required in a linear accelerometer.

(1)

(2)

(3)

(1) A movable mass, (2) a restraining and damping system, and (3) an output device.	36. In highly sensitive accelerometers, magnetic circuits are used to achieve damping; however, most linear accelerometers use both ________________ ________________ and ________________ ________________ to achieve damping.
calibrated springs damping fluid	37. Why is a restraining and damping system necessary in a linear accelerometer? ____ ____
To prevent the mass from overshooting or oscillating and inducing errors into the system.	38. What two methods are used to achieve damping in most linear accelerometers? (1) (2)
(1) Calibrated springs. (2) Damping fluid.	39. Occasionally, special components such as indicators and heaters are used with accelerometers. An aircraft "G" meter is an accelerometer which shows both the direction and amount of "G's" experienced during a flight. Accelerometers have many applications in aviation. The following sequence will enable you to: a. State the purpose of an indicator and a heater when used with linear accelerometers. b. List the three types of information which can be read on an aircraft vertical accelerometer ("G" meter). c. State four general uses of accelerometers. NO RESPONSE REQUIRED

	40. An indicator may be used with a linear accelerometer <u>to show</u> both <u>the direction</u> and <u>the amount</u> of measured changes of velocity. Because of the sensitivity required of some linear accelerometers (which must be able to respond to velocity changes as small as .0001 G's), the <u>temperature of the instrument must be held constant</u>. The <u>damping fluid must not be allowed to freeze</u> (or change its viscosity). An indicator, when used with an accelerometer, shows both the ______________ and the ______________ of acceleration. Heaters are sometimes used with accelerometers to maintain a constant ______________ and to prevent the damping fluid from ______________.
direction amount temperature freezing	41. An indicator is sometimes used with an accelerometer so that a pilot may know both the a. direction and amount of acceleration. b. distance and amount of acceleration. c. airspeed and velocity of acceleration.

a.	42. Modern aircraft fly at very high altitudes, encountering extremely cold temperatures which affect the operation of mechanical devices. Heaters are used with accelerometers to a. maintain a constant temperature and prevent the mass from freezing. b. maintain a constant temperature and prevent the damping fluid from freezing. c. maintain a constant humidity and prevent the damping fluid from evaporating. d. maintain a constant humidity and prevent the mass from freezing.
b.	43. Figure 43 shows the front view of a typical aircraft vertical accelerometer ("G" meter).

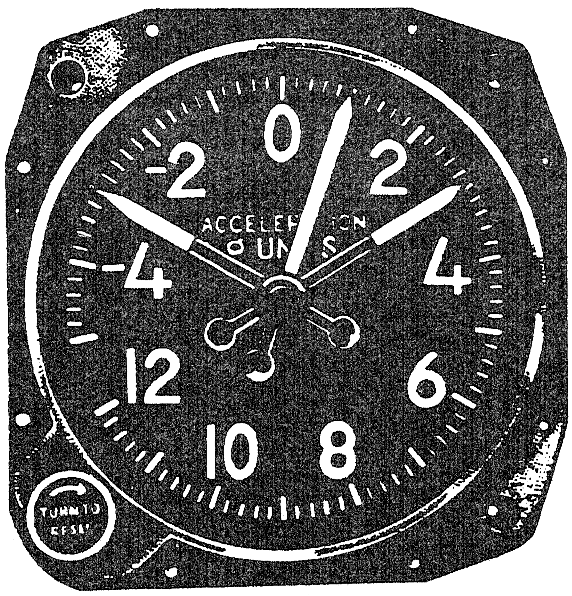


Figure 43

The center hand moves clockwise as the aircraft climbs and experiences <u>positive</u> <u>G's</u>. The auxiliary hand on the right is driven by the center hand; it can be

Continue to next page.

43. (Continued)

moved clockwise, but it will not return from its most positive reading until it is reset.

The center hand moves counterclockwise as the aircraft dives and experiences negative G's. The auxiliary hand on the left is driven by the center hand; it can be moved counterclockwise, but it will not return from its most negative reading until it is reset.

On the ground, or in level flight, the center hand indicates + 1 G, which is the normal force being applied to the structure of the aircraft.

On an aircraft vertical accelerometer, the center hand indicates ______________________________
(most negative/instantaneous/most positive)
G forces encountered;

the auxiliary hand, which is driven clockwise, indicates ______________________________ G forces
(most negative/instantaneous/most positive)
encountered; and

the auxiliary hand, which is driven counterclockwise, indicates ______________________________
(most negative/instantaneous/most positive)
G forces encountered.

instantaneous most positive most negative	44. Three types of information which can be read on an aircraft vertical accelerometer ("G" meter) are a. maximum instantaneous G's, maximum clockwise G's, and maximum counterclockwise G's. b. maximum positive G's, maximum negative G's, and instantaneous G's. c. instantaneous rotational G's, maximum positive G's, and maximum negative G's.
b.	45. Indicators and heaters are special components that may be used with accelerometers. The reason for using an indicator with an accelerometer is to show both the ______________ and the ______________ of acceleration. The reasons for using a heater with an accelerometer are: a. to maintain ______________________. b. to prevent ______________________.
direction amount a. a constant temperature b. the damping fluid from freezing.	46. Because of their ability to produce an output which is proportional to a measured change of velocity, linear accelerometers are used in many different applications. Four general uses of linear accelerometers are: (1) Aircraft safety devices -- they allow the pilot to know what stresses are being applied to his aircraft; Continue to next page.

	46. (Continued) (2) Inertial navigation -- they are the sensing instruments which measure changes of velocity so that position information can be calculated; (3) Loft-bombing systems -- they are used to allow the pilot to climb at a predetermined rate; and (4) Timing delays -- they are used in missiles to activate arming circuits or telemetering devices at a predetermined velocity. List four general uses of linear accelerometers. (1) __________ (2) __________ (3) __________ (4) __________
(1) Aircraft safety devices. (2) Inertial navigation. (3) Loft-bombing systems. (4) Timing delays.	47. Accelerometers have a wide variety of application. From the list below, select four general uses of linear accelerometers. a. Aircraft speedometers. b. Aircraft temperature devices. c. Aircraft safety devices. d. Initial velocity computers. e. Inertial navigation sensors. f. Missile launching devices. g. Loft-bombing reference devices. h. Timing delays.

c. e. g. h.	48. Figure 48 shows a mechanical drawing of an aircraft accelerometer. As the mass moves up and down, it causes the main pointer to indicate instantaneous G's. The main pointer drives one auxiliary pointer clockwise, recording the most positive G's encountered, and it drives the other auxiliary pointer counterclockwise, recording the most negative G's encountered. The ratchet assemblies keep the auxiliary pointers at their maximum readings until they are reset with the control.

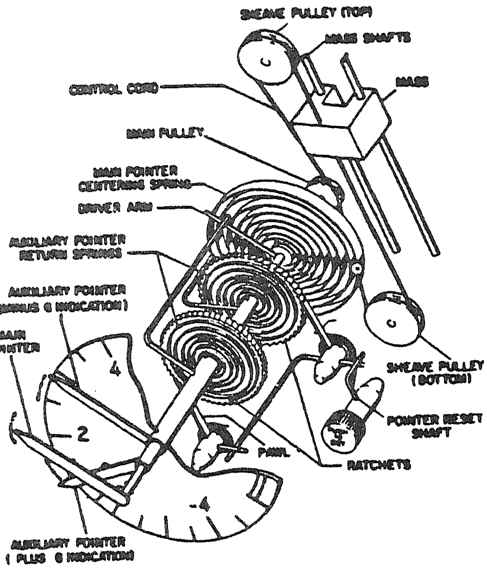


Figure 48

Three types of information which can be read on an aircraft vertical accelerometer are

(1) ______________________________

(2) ______________________________

(3) ______________________________

(1) instantaneous G's, (2) maximum positive G's, (3) maximum negative G's.	49. What is the purpose of an indicator and a heater used with a linear accelerometer? a. Indicator -- b. Heater --
a. To show both the direction and amount of acceleration. b. To maintain a constant temperature and prevent the damping fluid from freezing.	50. Various types of accelerometers have been shown throughout this program. The vertical reference accelerometer is used both as an aircraft safety device and as a reference device in loft bombing. The force-balance accelerometer is used in inertial navigation systems. The pulse-counting accelerometer can be used as a timing delay in a missile system. List four general uses of linear accelerometers. (1) ____________ (2) ____________ (3) ____________ (4) ____________
(1) Aircraft safety device. (2) Inertial navigation. (3) Loft bombing. (4) Timing delay.	51. What three types of information can be read on an aircraft vertical accelerometer ("G" meter)? (1) ____________ (2) ____________ (3) ____________

(1) Instantaneous G's. (2) Maximum positive G's. (3) Maximum negative G's.	52. What are four general uses of linear accelerometers? (1) __________ (2) __________ (3) __________ (4) __________
(1) Aircraft safety devices. (2) Inertial navigation. (3) Loft bombing. (4) Timing delays.	

YOU HAVE COMPLETED THIS PROGRAM. NOTIFY YOUR INSTRUCTOR.

Q-6A

ACCELEROMETERS

REVIEW TEST

NAME ____________________ RATE __________ CLASS ________ DATE _________

1. Match the following words with their correct definitions by placing the letter of the word in the space provided with each definition.

a. Speed	____	The rate of change of velocity of a moving object.
b. Velocity		
c. Acceleration	____	The property of a body at rest to remain at rest.
d. Accelerometer	____	A measurement of force using normal weight as a reference.
e. Inertia		
f. "G" unit	____	Mechanical instrument used to detect a change in velocity.
	____	The rate of change of position.
	____	The magnitude of velocity.

2. Write the formulas used to calculate velocity and acceleration.

   a. Velocity --

   b. Acceleration --

3. Each characteristic of an accelerometer listed below pertains to either a linear or an angular accelerometer. If it pertains to a linear accelerometer, place an "L" in the space provided; if it pertains to an angular accelerometer, place an "A" in the space provided.

____ Measures rate of change of angular (rotational) velocity.

____ Consists of a movable mass.

____ Measures straight-line rates of change of velocity.

____ Has a differentiated output.

____ Usually a modified rate gyro.

4. What is the input to a linear accelerometer?

5. List the three basic components required in a linear accelerometer.

(1)

(2)

(3)

6. Why is a restraining and damping system necessary in a linear accelerometer?

7. What two methods are used to achieve damping in most linear accelerometers?

(1)

(2)

8. What is the purpose of an indicator and a heater used with a linear accelerometer?

a. Indicator --

b. Heater --

9. What three types of information can be read on an aircraft vertical accelerometer ("G" meter)?

(1)

(2)

(3)

10. What are four general uses of linear accelerometers?

(1)

(2)

(3)

(4)

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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